03-12-01 JC09 Rec'd PCT/PTO 09 MAR 2001

FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **100.1003**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **09/786993**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP 99/06531	**9 June 1999**	**9 June 1998**

TITLE OF INVENTION
Electronic circuit for recording of geographic position data on the audio channel of a camcorder

APPLICANT(S) FOR DO/EO/US
Ralf A. Sood

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau) (translation)
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

- Translation of German Patent Office Search Report

- Cover page of German Priority Application Publication

- German Patent Office Search Report

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/786993	PCT/EP 99/06531	100.1003

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**	
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO **$860.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	

ENTER APPROPRIATE BASIC FEE AMOUNT =	**$860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	4 - 20 =	0	x $18.00	**$0.00**	
Independent claims	2 - 3 =	0	x $80.00	**$0.00**	
Multiple Dependent Claims **(check if applicable).**			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$860.00**	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable).** ☐				**$0.00**	
SUBTOTAL =				**$860.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$860.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☒				**$40.00**	
TOTAL FEES ENCLOSED =				**$900.00**	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$900.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **50-0552** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

DAVIDSON DAVIDSON & KAPPEL, LLC
485 Seventh Avenue, 14th Floor
New York, New York 10018
(212) 736-1940

SIGNATURE

Cary S. Kappel
NAME

36,561
REGISTRATION NUMBER

March 9, 2001
DATE

100.1003

UNITED STATES PATENT & TRADEMARK OFFICE

Re: Application of: SOOD, Ralf A.

Serial No.: To Be Assigned

Filed: Simultaneously Herewith

For: **ELECTRONIC CIRCUIT FOR RECORDING OF GEOGRAPHIC POSITION DATA ON THE AUDIO CHANNEL OF A CAMCORDER**

PRELIMINARY AMENDMENT

Box:
Assistant Commissioner for Patents
Washington, D.C. 20231

March 9, 2001

Sir:

Prior to examining the application, kindly amend the original published claims as follows:

IN THE SPECIFICATION

Please replace the title "System for processing geographic position data and images and circuit for said system"on page 1, line 1-2, with – Electronic circuit for recording of geographic position data on the audio channel of a camcorder –.

Please replace the heading "Technical Field" on page 6, line 1 with -- Field of the Invention –.

Please replace paragraph 1 (page 1, line 6-7) with the following rewritten paragraph:

--The invention relates to an electronic circuit for recording of geographic position data on

the audio channel of a camcorder in accordance with the preamble of claim 1. --

Please replace "Prior art" on page 1, line 10 with – Background of the Invention –.

Please replace paragraphs 2 - 4 (page 1, lines 11-24) with the following rewritten paragraphs:

--Systems are known that process geographic position data, in particular from satellite navigation, as well as images. DE-A-19733683 describes a portable computer having a removable digital camera and a GPS adapter for position determination, wherein the captured images and the capture positions are stored in the memory of the computer. A digital land map can be displayed on the screen of the computer that shows the capture sites of the images. When the user selects a capture site, the corresponding images are shown on the screen. DE-A-19505487 describes a vehicle navigation system that employs image information captured by a camera as an additional navigation aid.

A vehicle navigation system is known from JP-A-09033271 (abstract from "Patent Abstracts of Japan"/JAPIO) in which, *inter alia*, a camera, a GPS position sensor, a map data memory, a controller and a display are fixedly connected to one another via a data line. When the display displays a scene captured by the camera, an object contained in the scene can be displayed *e.g.* with its name on a map on the display. In use, all of the listed components must be present and switched on since the controller must alternately access these in order to execute the described functions.

From JP-A-092922245 and JP-A-08023503, it is known to record position data in the form of speech and audio frequency signals, respectively, on the audio channel of a camcorder. --

Please replace paragraphs 5-13 (page 1, line 28 to page 3, line 32) with the following rewritten paragraphs:

--It is an object of the invention to provide an electronic circuit for the recording of geographic position data on the audio channel of a camcorder that is simply constructed, is easy to use on the go and thus represents an useful instrument for photographers and video cameramen.

For an electronic circuit of the given category, this object is achieved by the characterizing features of claim 1.

The circuit in accordance with the invention, in conjunction with a system for processing geographic position data and images allows *e.g.* an amateur movie maker equipped with a camcorder (a portable camera recorder having a digital image sensor and analog or digital recording), a GPS receiver (a satellite navigation device for GPS (Global Positioning System), GLONASS (Global Orbiting NAvigation Satellite System) or GNSS (Global Navigation Satellite System) such as are becoming increasingly popular among amateurs) as well as an appropriately equipped personal computer to reference the captured image sequences in a simple manner to the corresponding capture sites.

To accomplish this, the user on the go connects the GPS receiver to the camcorder via the first circuit part of the electronic circuit. During filming, the current geographic position of the camcorder is recorded onto a recording medium such as *e.g.* a magnetic tape synchronized or nearly synchronized with the images.

At home, the user connects the video output of the camcorder and an electronic circuit for reading out the position data recorded on the audio channel to a computer such as *e.g.* a personal computer on which the data processing program is installed.

The data processing program effects the presentation of a land map on the screen of the personal computer and marks, thereon, sites for which recorded images exist and which it has recognized on the basis of the parallel recorded position data. When one clicks, *e.g.* via the mouse, on a marked site, the corresponding, available image sequences are presented on the screen.

Since a camcorder typically also records the recording time, and/or the recording times are contained in the GPS information, the data processing program can furthermore compute a traveled route and display it on the screen. If the map material comprises traffic routes, the user can, for example, designate that the data processing program stick to particular traffic routes or to the respectively shortest traffic route for the presentation of the capture site and the traveled route. In other cases or on overview maps, the data processing program can, for instance, simply connect the capture sites in chronological order.

Via an editing program such as are also commonly used by amateur movie makers for retouching/editing of film material, the film and map sequences can be concatenated into a complete movie and output for recording on a conventional video recorder.

The invention is not only applicable for amateur movie makers, but also extremely advantageous in professional applications. This is true not only in connection with camcorders, in particular journalists' camcorders or so-called EFP or ENG camcorders, but also in connection with any type of digital video cameras with digital or analog recording and/or transmission of the image data. In professional applications, *e.g.* reports, a radio transmission in real time or time-delayed, *e.g.* by means of a transmission truck, is an alternative to the transmission of the image and position data on a transportable storage medium.--

On page 20, line 31, please replace "Embodiments of the invention" with -- Detailed Description of the Preferred Embodiments--.

On page 27, line 1, please replace "**CLAIMS**" with – I claim: –.

IN THE CLAIMS

Please cancel claims 1-27 without prejudice.

Add new claims 28-31 as follows:

28. (New) An electronic circuit having an input that receives geographic position data that are coded as serial digital signals and an output that outputs the geographic position data in the form of signals that are suitable for recording onto an audio channel of a camcorder wherein the electronic circuit includes one of:

a level converter that solely carries out a level conversion to the serial digital signals in order to record the level converted serial digital signals, as they are, onto the audio channel of the camcorder; and,

a signal inverter and a level converter that solely carries out level conversion and inversion to the serial digital signals in order to record the level converted and inverted serial digital signals, as they are, onto the audio channel of the camcorder.

29. (New) A system for the reading out and processing of image data recorded in a camcorder and geographic position data comprising:

an electronic circuit having an input that receives geographic position data that are coded as serial digital signals and an output that outputs the geographic position data in the form of signals that are suitable for recording onto an audio channel of a camcorder wherein the electronic circuit includes one of:

a level converter that solely carries out a level conversion to the serial digital signals in order to record the level converted serial digital signals, as they are, onto the audio channel of the camcorder; and,

a signal inverter and a level converter that solely carries out level conversion and inversion to the serial digital signals in order to record the level converted and inverted serial digital signals, as they are, onto the audio channel of the camcorder; and,

a data processing program that is adapted to display at least one digital land map on a screen to display the capture sites of images or image sequences represented by the image data on the at least one land map and to display, when the user selects a capture site, the corresponding images or image sequences, wherein the at least one digital land map comprises at least one digital world map that is displayed in the form of a parallel projection onto the globe, wherein the global is virtually rotatable by the user.

30. (New) The system of claim 29 wherein the data processing program further comprises an editing program such that a movie for recording on a video recorder can be put together from at least one land map selected by the user as well as images or image sequences selected by the user.

31. (New) The system of one of claim 28 wherein the data processing program further comprises a communication program such that recorded geographic position data are sent for an external difference correction and the corrected position data are received back.

REMARKS

Claims 1 - 27 have been canceled and new claims 28-31 entered to more clearly point out what applicants regard as the invention, and claims 28-31 are pending in the present application. The present invention is new, useful and non-obvious.

Applicant wishes to advise the Examiner that a substitute specification in paragraph-numbered format is forthcoming.

An early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

DAVIDSON, DAVIDSON & KAPPEL, LLC

By_____
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TRANSLATION

GERMAN PATENT AND TRADEMARK OFFICE

Munich, May 6, 1999
File Ref. : 198 41 262.2-52
Applicant: iBS integrierte
Business Systeme GmbH
Your ref.: IBS 01

Request for examination effective as of September 22, 1998

The examination of the above-mentioned patent application has had the following result.

A term of 4 months starting upon service is granted for a response to this office action.

Of each of the documents that are possibly enclosed to the response (e.g., patent claims, description, parts of the description, drawings) two copies must be filed on separate sheets. Of the response itself only one copy is required.

If the patent claims, the description or the drawings are amended in the course of the proceedings, the applicants must state in detail where the features of the invention described in the new documents are disclosed in the original documents. The above does not apply to amendments carried out by the patent Office.

With the present documents, grant of the patent can not be prospected; rather rejection of the application should be expected. If a response on the merits is not intended, we ask for an informal notification about receipt of this office action.

In this office action, the following citations are mentioned for the first time. (Their numbering will be maintained throughout the further proceedings):

1) JP 09033271 A (Abstract from "Patent Abstracts of Japan"/JAPIO)
2) JP 07288725 A (Abstracts from WPIDS" and "Patent Abstracts of Japan"/JAPIO)
3) JP 09033277 A (Abstract from "Patent Abstracts of Japan"/JAPIO)
4) JP 092922245 A (Abstract from "Patent Abstracts of Japan"/JAPIO)
5) WO 98/22831 A1

From citation 1) there is known a system for processing geographic position data and images, comprising an electronic circuit 1, 3, 6 - 8 having circuit parts for common input (positions by GPS 3 and "control part"6 in conjunction with "map-data memory part"7, images by "camera"1) and output (on the "display"8") of geographic position data and images, wherein after selection of a location ("object", "substance") there are displayed a map containing the location and a matching image which relates to the location.

Thus all substantial features of claim 1 of the application can be learned from citation 1).

Also from citations 2) - 5), in particular citation 2), all substantial features of claim 1 can be learned. Thus claim 1 is not allowable for lack of novelty.

With regard to subclaims 2 - 24, which are not allowable also for formal reasons, the following is to be stated:
The subject matter of the claims as mentioned hereinafter are either known from the citations as mentioned also hereinafter, or it they would be obvious to a person skilled in the art having knowledge of these citations:

Claims 2 and 3: Citations 1) - 4),
Claims 4 - 6: Citations 4) or 5),
Claims 7-11, 14-18 and 20-22: Citations 1) - 5),
Claims 12 and 13: Citation 1)
Claim 19: Citation 3) and
Claim 23: Citations 2) or 4).

With respect to the subject matter of claim 24, the examination office at present does not know any conflicting documents.

Device claim 25 comprises as clear device features a "level converter", or a "signal inverter" and a "level converter". However, such electronic circuit parts are notorious and seem to be used also in the devices of citations 1) - 5) - although not explicitly stated there. Therefore claim 25 is not allowable.

At this point it is pointed out that in a device claim, particulars of an application (in claim 25: "for recording ... on the audio channel of a camcorder") does not limit the scope of

this claim to this application (see e.g. SCHULTE Patent Law 5. Edition § 14 PatG margin notes 51 ff.)

With respect to the subclaims 26 - 28, which are not allowable also for formal reasons, the following is to be stated:

Also claim 26 includes notorious subject matter.

With respect to the subclaims 27 ans 28 it is referred to citations 1) - 5) and to the above explanations in this connection.

With the current patent request, grant of a patent is not possible.

Examiner for class G 01 C

IPER

Electronic circuit for recording of geographic position data on the audio channel of a camcorder

Technical field

The invention relates to an electronic circuit for recording of geographic position data on the audio channel of a camcorder in accordance with the preamble of claim 1.

Prior art

Systems are known that process geographic position data, in particular from satellite navigation, as well as images. DE-A-19733683 describes a portable computer having a removable digital camera and a GPS adapter for position determination, wherein the captured images and the capture positions are stored in the memory of the computer. A digital land map can be displayed on the screen of the computer that shows the capture sites of the images. When the user selects a capture site, the corresponding images are shown on the screen. DE-A-19505487 describes a vehicle navigation system that employs image information captured by a camera as an additional navigation aid.

A vehicle navigation system is known from JP-A-09033271 (abstract from "Patent Abstracts of Japan"/JAPIO) in which, *inter alia*, a camera, a GPS position sensor, a map data memory, a controller and a display are fixedly connected to one another via a data line. When the display displays a scene captured by the camera, an object contained in the scene can be displayed *e.g.* with its name on a map on the display. In use, all of the listed components must be present and switched on since the controller must alternately access these in order to execute the described functions.

From JP-A-092922245 and JP-A-08023503, it is known to record position data in the form of speech and audio frequency signals, respectively, on the audio channel of a camcorder.

Summary of the invention

It is an object of the invention to provide an electronic circuit for the recording of geographic position data on the audio channel of a camcorder that is simply constructed, is easy to use on the go and thus represents an useful instrument for photographers and video cameramen.

For an electronic circuit of the given category, this object is achieved by the characterizing features of claim 1.

The circuit in accordance with the invention, in conjunction with a system for processing geographic position data and images allows *e.g.* an amateur movie maker equipped with a camcorder (a portable camera recorder having a digital image sensor and analog or digital recording), a GPS receiver (a satellite navigation device for GPS (Global Positioning System), GLONASS (Global Orbiting NAvigation Satellite System) or GNSS (Global Navigation Satellite System) such as are becoming increasingly popular among amateurs) as well as an appropriately equipped personal computer to reference the captured image sequences in a simple manner to the corresponding capture sites.

To accomplish this, the user on the go connects the GPS receiver to the camcorder via the first circuit part of the electronic circuit. During filming, the current geographic position of the camcorder is recorded onto a recording medium such as *e.g.* a magnetic tape synchronized or nearly synchronized with the images.

At home, the user connects the video output of the camcorder and an electronic circuit for reading out the position data recorded on the audio channel to a computer such as *e.g.* a personal computer on which the data processing program is installed.

The data processing program effects the presentation of a land map on the screen of the personal computer and marks, thereon, sites for which recorded images exist and which it has recognized on the basis of the parallel recorded position data. When one clicks, *e.g.* via the

mouse, on a marked site, the corresponding, available image sequences are presented on the screen.

Since a camcorder typically also records the recording time, and/or the recording times are contained in the GPS information, the data processing program can furthermore compute a traveled route and display it on the screen. If the map material comprises traffic routes, the user can, for example, designate that the data processing program stick to particular traffic routes or to the respectively shortest traffic route for the presentation of the capture site and the traveled route. In other cases or on overview maps, the data processing program can, for instance, simply connect the capture sites in chronological order.

Via an editing program such as are also commonly used by amateur movie makers for retouching/editing of film material, the film and map sequences can be concatenated into a complete movie and output for recording on a conventional video recorder.

The invention is not only applicable for amateur movie makers, but also extremely advantageous in professional applications. This is true not only in connection with camcorders, in particular journalists' camcorders or so-called EFP or ENG camcorders, but also in connection with any type of digital video cameras with digital or analog recording and/or transmission of the image data. In professional applications, *e.g.* reports, a radio transmission in real time or time-delayed, *e.g.* by means of a transmission truck, is an alternative to the transmission of the image and position data on a transportable storage medium.

The invention is furthermore suitable for still cameras, *i.e.* cameras that capture single images such as photographic cameras having a digital image sensor and digital and/or analog recording of images and additional information. APS (Advanced Photo System) cameras having a conventional film for the images and a magnetic strip for digital data running in parallel can be equally used. In order to be able to use, in this case, all functions that the system offers, the photographs can be scanned into the computer.

The video cameras and still cameras that come into consideration are not limited to visible light, but could also be *e.g.* thermal cameras for infrared light with which thermal images of buildings or landscapes can be captured.

In the case of a camcorder, there are several different possibilities for recording the position data together with the images. A technically particularly simple method that, in accordance with the invention, is preferred comprises connecting the first circuit part at least temporarily to a microphone or audio input of the camcorder and recording the position data essentially synchronously with the image data on at least one audio channel of the camcorder, *i.e.* on one of more audio tracks of the recording medium. Mobile devices for automatically determining the current geographic position such as *e.g.* GPS receivers typically output the position data in the form of digital signals that are recorded either directly in digital or by means of audio modulation in analog that can be later read by the electronic circuit.

Whereas cameras with mono audio recording cannot record any further audio when the audio channel is constantly laden with GPS coordinates, one of the two stereo channels in camcorders having stereo audio recording suffices for a continuous recording of the GPS coordinates. The audio channel or both audio channels are available for audio recording in spite of recording of the GPS coordinates if the audio channel is respectively switched over to the GPS receiver only for a short time, *e.g.* for two seconds. Normal audio recording is again carried out subsequently. Nearly undisturbed audio operation is thus possible. The short switching over can be carried out *e.g.* by having the user press a button (for instance when the recording button of the camera is actuated), automatically after a delay subsequent to switching on of the camcorder and/or automatically in regular intervals. Since the camcorder

is hardly moved during a recording phase with respect to the achievable positional resolution, one set of GPS coordinates per recording phase typically suffices.

The achievable bandwidth allows pure GPS coordinates to be recorded as frequently as images, albeit not exactly synchronized. Normally it is not particularly disturbing or it is subsequently easily corrected if the correspondence between the coordinates and the camera images is not exactly image synchronous, but is instead offset by a few images due to insufficient synchronization or low bandwidth.

The circuit and, as the case may be, the mobile device for position determination such as *e.g.* a GPS receiver can be supplied with power from the internal power supply of the camcorder. Preferably, a GPS antenna and a GPS receiver which are also commercially available as an integral component are located in a small housing together with the electronic circuit and an RS-232 computer interface therebetween. On the housing, there are, for instance, a state display for the reception quality, setting elements for the data format and data contents of the position data written on the audio track, a plug connector for connection to the camcorder and a plug connector for connecting to the RS-232 interface of a computer. A version for professional users supports time codes (temporally distributed codes) for audio or time code channels such as VITC (Vertical Internal Time Code), LTC (Longitudinal Time Code) of the SMPTE (Society of Motion Picture and Television Engineers) and/or various computer interfaces for output and DGPS (Differential GPS).

Not only GPS receivers, which, in the present case, are to be understood as all receivers for GPS and/or GLONASS as well as, in the future, also GNNS, but also other position determining devices having a radio connection to at least three known transmitter or satellite positions and propagation time measurement are suitable as mobile devices for geographic position determining in terms of longitude, latitude and altitude (as absolute values with regard to the center of the earth and altitude over its surface).

In principle, it is possible to determine the geographic position when three fixed points are known and the distances of the fixed points can be computed from the propagation and the speed of light. Corresponding devices are based, for example, on position determination via

terrestrial cellular networks which will be possible in the future, in particular in the field of mobile radio communications. Such devices work with higher frequencies (>1 GHz) than GPS devices and take into consideration satellite networks in lower orbits than the GPS system. In this manner, numerous mobile electronic devices are, in principle, capable of determining/computing their position.

Terrestrial radio communication cells of mobile radio communication networks based on digital data exchange have the additional advantage that the positions of the at least three fixed points, namely of the nearby base stations, are precisely known and that even a point-to-point duplex data connection is established. The computational power *e.g.* of a mobile phone provides sufficient performance reserves for the necessary computations. The digital land maps needed by the invention can even be stored in and/or transmitted by the mobile radio communication device and route suggestions or the course of routes can be displayed on a small screen of the mobile radio communication device.

Mobile computers such as *e.g.* palmtops that are connected to a mobile radio communication device or contain a suitable radio receiver also come into consideration as mobile devices for geographic position determination. The data processing program of the invention can also be installed on such a mobile computer such that the user can use the invention in its full scope even during travel.

All these known and future systems for geographic position determination will be designated, in general, hereinafter as GP systems.

A system in accordance with the invention having a GPS receiver furthermore comprises, in a further embodiment of the invention, a receiver for terrestrially (*e.g.* via the mobile radio communication network) radioed GPS reference data that is connected with the mobile device. This allows a difference correction of the GPS coordinates by means of the known DGPS (Differential GPS) method on the basis of the reference data, wherein a particularly high positional accuracy on the order of 1 meter can be achieved. Alternatively, such a difference correction can be carried through later reprocessing of the position data. If the computer of the system user comprises a communication connection to *e.g.* the internet, the

data processing program can download the necessary correction data, for instance from a system manufacturer's server and carry out the difference correction on its own or, alternatively, send the positions and the capture times of the images to the server, from which subsequently receives back the corrected data. Recommended standards for the difference correction are described, for example, in the World Wide Web on the web site http://www.navcen.uscg.mil/policy/dgps/rtcm104/default.html of July 28, 1998.

In order to bridge occasionally insufficient reception from transmitters and/or satellites as can be the case, for instance, in buildings, a gyro sensor system comprising acceleration sensors operating on an electromechanical or photoelectric (laser gyro) basis or a conventional gyroscope can be integrated into the GPS receiver. The gyro sensor system represents an inertial system with whose aid the position determination can be continued in the meantime.

In accordance with a further embodiment of the invention, the system additionally comprises an electronic compass that captures the capturing direction of the images or image sequences represented by the image data and records and/or transmits the corresponding direction data, in addition to the position data, together with the image data. The electronic compass can be a 2-D compass for determining the direction on the four points of the compass in which the camera lens is pointing during capture or a 3-D compass for additionally determining the slope of the camera relative to the horizon. The directional information simplifies later evaluation of the captured images/image sequences on the computer and allows additional useful effects.

The position signals of conventional GPS receivers are typically in the form of serial digital signals, *e.g.* NRZ (Non-Return to Zero) signals. It turns out that, in this case, the first circuit part solely has to carry out an inversion and level conversion of the serial digital signals in order for the reduced-level TTL signals generated in this manner to be directly recorded onto the audio track of a fully digital camcorder. One can even leave out the inversion; however, the data recorded onto the audio track no longer represent standard TTL signals. In the case of a camcorder having analog recording and that cannot simply process the high data frequencies that occur, the signals can be temporally dilated, *i.e.* either a digital speed conversion or an analog frequency conversion is carried out.

In the case of a GPS receiver having NRZ output signals that are computer-readable via an RS-232 interface, it is practical when the second circuit part recreates the original NRZ signal form of the serial digital signals when the position data are read out.

In order for the data processing program to be able to directly process this information, it is practical when the GPS receiver or other GP device supplies the geographic position data in a standardized format. A typically format for GP information is the NMEA-0183 code set described, for example, in the World Wide Web on the web site http://www.marinesoft.com/Navigation/Technical/mse4.html of July 27, 1998. In accordance with the invention, however, GP information from GP devices that supply other standard formats and/or proprietary raw data formats can be recorded and/or transmitted. In the case of device-specific raw data, the data processing program must carry out interpretation thereof or the manufacturer of the system in accordance with the invention offers this, *e.g.* as an internet service.

The GP information encompasses the following information, not all of which is necessary for the invention: date and time in various number systems, position information in various coordinate systems, information re (difference) corrected or uncorrected, number and IDs/designations of the receivable and used satellites or radio cells, HDOP (Horizontal Dilution Of Precision), VDOP (Vertical Dilution Of Precision), GDOP (Geocenter Dilution of Precision), TDOP (Time Dilution of Precision), altitude unit, age of correction information, station information, time of the last site determination, parity/check data, signal strength, system operation mode information, information re deviation between GPS and GLONASS and/or GNSS system, operating state of the satellites and radio cells, the receiver and, as the case may be, the reference receiver, error information, range error and correction information (as absolute or relative values), information re the distance to the center of the earth, synchronization information, almanac and ephemeral information of the satellites, direction and speed information, information re the azimuth and elevation of the satellites, event markings, week, day and time unit counters in various number systems, era information, information re the direction to the magnetic north pole, zone information, information re the generated message format, parameter and status information.

In a preferred embodiment of the invention, the data processing program is adapted to display

a traveled route on the at least one land map on the screen on the basis of the capture sites of the images or image sequences represented by the image data and to display capture sites lying on or next to the traveled route via symbols, blended in text or, in the case of sufficient screen resolution, single miniature images from the images or image sequences. When the system, for instance, first displays symbols, the user can, during subsequent editing, input a caption or a selected image that is to replace the symbol. By clicking the symbols or the like, the corresponding images or film sequences are displayed in a larger format, or a menu appears first, in which the capture sites or images are listed in accordance adjustable criteria. In accordance with the user's choice, and in agreement with the screen resolution, several land maps and the corresponding menus can be displayed on the screen either sequentially or together.

In a preferred embodiment of the invention, the data processing program has a so-called zoom function, *i.e.* the user can, *e.g.* using the mouse, mark an arbitrary section on any land map currently displayed on the screen that is subsequently displayed, in enlargement, on the screen, wherein this operation can be repeated as desired and/or depending on the quality of the available map material.

Preferably, a digital world map is shown on the screen at the first, *e.g.* after the start of the data processing program, that the user can zoom in on. A particularly applicable world map is in the form of a parallel projection onto the global, *i.e.* corresponds to a natural view from a very large distance, wherein the user can virtually spin the globe *e.g.* with the aid of the mouse and the cursor until the section of the earth that interests him points to the front.

In a preferred embodiment of the invention, the data processing program comprises an editing program or can work in conjunction with an editing program such that a film can be "spliced" together from at least one land map selected by the user as well as from images or image sequences selected by the user for recording on a conventional commercial video recorder.

For the aforementioned difference correction of the position data in the context of an external editing, the data processing program can comprise a communication program or work in conjunction with a communication program such that geographic position data recorded in

connection with images or image sequences are sent *e.g.* as electronic mail and the corrected position data are received back.

The first circuit part of the system in accordance with the invention, *i.e.* the electronic circuit for recording of geographic position data can be implemented in various ways.

A particularly simple circuit that allows the recording of position data that are represented by serial digital signals on the audio channel of a camcorder essentially consists of a level converter or of a signal inverter and a level converter. Such a circuit can be constructed at very low cost from a conventional commercial integrated circuit in energy saving CMOS technology and several passive electronic components. In a preferred embodiment, the electronic circuit, together with a mobile device for automatically determining the current geographic position and for output of corresponding position data, for instance a GPS receiver, forms a compact, integral device that comprises only three electrically conductive connections to the camcorder, namely a signal line, a power supply line and a ground line.

The second circuit part of the system in accordance with the invention, *i.e.* a circuit for reading out the position data from the audio channel of the camcorder recreates, in a preferred embodiment, the original signal form of the serial digital signals. This signal regeneration circuit can be equally implemented in an relatively simple manner. The signal regeneration circuit can be housed either in the same housing as the signal recording circuit, wherein, for practicality's sake, an energy saving circuit is provided that deactivates it when not in use, or in a separate housing that the system user need not take with him on his trip since the signal regeneration circuit is only required for transmitting the data onto the computer.

Further possibilities for storing and/or transmitting the geographic position data in other ways than on the audio channel of a camcorder are:

1. coded in the picture fly-back in the case of video systems (VITC or the like)
2. coded in the visible image in the case of video systems and still cameras
3. in the control track in the case of video systems
4. via LTC on the audio track

5. via RCTC (Rewritable Time Code) by Sony in the case Video8/Hi8

6. in the digital image and audio data used in digitally recording video cameras (in this case, image and audio segments are recorded, temporally offset, via a time multiplex method). These cameras have sufficient data bandwidth and storage for their own recording methods for the coordinates and GP information corresponding to the particular application and even for land maps.

7. using the digital storage means used in still cameras. For instance, chip cards are suitable as a storage medium.

8. in accordance with the APS method, as discussed above, in hybrid still cameras.

The GP recording can be carried out continuously, in response to an event or periodically. Furthermore, sequential position numbers (and thus scene and image numbers) can be recorded.

The aforementioned storage possibilities 1 to 8 will elucidated in further detail hereinafter:

Re 1.: VITC is a standardized method of the SMPTE for recording the hour, minute, second and frame number in each frame (full image) in the case of analog video recording and transmission methods. In this case, a storage range of 80 bits is defined in one of the fly-back lines of the television picture. VITC is thus part of the invisible television picture. The 80 bits are split into time code bits and user bits. One uses either the entire range or only the user bit range for the coordinates. Although the limitation to the user bits offers higher compatibility with available devices, it does not offer enough room for a GP coordinate, whence one must distribute a GP message among several images. For the invention, it is practical to distribute a full "starting coordinate" over several images once and then to solely store the relative deviations in the following user bits. VITC is seldom offered in cameras of the entertainment electronics industry, but is instead only offered as an integrated function in costly studio cameras. Costly video editing devices can insert this code afterwards.

Re 2.: In the visible area of the picture, several manufacturer-specific areas can be defined in which the GP coordinates and/or GP information can be stored. This method is furthermore image synchronous.

Re 3.: Synchronous signals are normally recorded parallel to the images in the control track (CTL track) in VHS/SVHS cameras. Using known time code methods such as RAPID (registered trademark) or the like, the control signals are obtained and supplemented with time code information. The time code is similar to that of VITC, is structured, however, with 50 bits and can be at least laden with partial coordinate data in the user bits. As a rule, however, RAPID requires 50 images, 2 seconds, for a time code. The RAPID method is only used with the PAL method. Due to the low bandwidth, recording in accordance with the invention turns out to be image overlapping and not image synchronous.

Re 4.: LTC is also standardized by the SMTE and is written in an audio or time code channel on a video or audio recorder. It can be recorded before, during or after the recording of video images. It can only be read when the magnetic tape moves.

Re 5.: Similar to RAPID, but precise to each image. In the case diagonal track recording, it is recorded between the video signal and PCM (Pulse Code Modulation) audio.

Re 6.: The digital storage that is becoming more and more widespread in video cameras offers numerous possibilities for storing digital GP data as an integrated function of the camera and to digitally transmit them to a computer, editing device or recorder. Sufficient data bandwidth is available. PC adapter cards are already commercially available with which the digital audio and image data can be transmitted in real time.

Re 7.: Although digital still cameras not yet allow the user to input externally GP coordinates and/or GP information, suitable connection options could, however, sooner or be provided by the manufacturers. Digital still cameras compress the individual image either loss-free or lossy using suitable compression methods. The GP coordinates and/or GP information could be stored without any problem on their digital storage media (often PCMCIA storage cards, standard for mini-PC interface).

Re 8.: APS represents a combination of traditional film and a magnet strip. The GP coordinates and/or GP information could also be stored on this magnetic strip.

In general, the invention addresses the association between position data and/or GP information, moving and still images and land maps as well as the integration and/or processing and presentation of these objects on a computer, optionally via video editing. Through visualization of the land maps provided with the GPS coordinates, the invention makes it easier to answer the question re where the particular images were captured.

For the transportation of the film, image, audio, GP and/or compass data material from the capture site to the processing station, *i.e.* to the computer, any of the following transmission paths is preferred:

A) time-delayed radio transmission (batch data transmission)
B) radio transmission in real-time (live data transmission)
C) time-delayed transmission via transportation of a storage medium

The choice of transmission path depends essentially on the application for which a concrete embodiment of the invention is conceived.

Professional fields of application encompass, for example:

- on-site reports in conjunction with land maps, wherein time is an important factor. A current film scene is directly transmitted (transmission path B) via a transmission truck (for instance via SNG, Satellite News Gathering).

- by means of so-called ENG, a type of current acquisition that, among others, is offered by the firm Panasonic in the context of a system called DVCPRO, in conjunction land maps, wherein a report is composed/edited in the vicinity of the capture site in as close to real-time as possible and transmitted either via A), B) or C) for editing/ broadcasting.

- stationary film editing applications with or without additional digital animation for preparation of video films recorded primarily via C).

- applications in the field of accident investigation, police, fire department, environmental protection, tourism advertising, transport and logistics, real estate, commercial sector information services, city planning, internet services, primarily via C).

- infrared and residual light amplifying cameras with time-delayed integration of land maps via A) or C).

- inclusion of real images and film sequences in the production of virtual worlds via C).

For applications in semi-professional fields and in the field of entertainment electronics, predominantly the transmission path C) comes into consideration. The positions and routes can be displayed not only on the home computer, but also on the go, *e.g.* on a palmtop computer or on a mobile telephone used for position determination. Such a mobile telephone can moreover serve to send off POI (Point Of Interest) queries and to display the information received thereto. Such information comprises *e.g.* tourist attractions, the next gas station with lowest price, hotels, personalized street traffic information, cities, tourist attractions, cultural, industrial and military sites, monuments, arboreal census information for forest registrars, street traffic sign, bridge, tunnel and other object coordinates, the location of ship wrecks and other underwater objects ("land maps" in the present context are also to be understood in the sense of marine maps and mixed maps), natural phenomena such as *e.g.* lightning, flora, fauna, astronomy, tornadoes and catastrophes.

A large number of suitable digital land maps for the system are available in various formats (for instance as image, site, grid or vector map material). Suitable land maps can be supplied together with the data processing program, or the data processing program can access *e.g.* map material from popular image processing programs or from the internet.

The computer and/or the data processing program can carry out *e.g.* the following operations on the coordinates and/or capture directions and images captured on-site: capturing and/or registration, processing and/or editing and combining and/or mixing with available site, vector and grid information, visualizing and storing in conjunction with other data without

reference to the digital land maps and integrating, visualizing, storing and transmitting with site, grid and/or other vector maps or other data.

As was already touched upon above, the maps can be placed and used on the screen alternately or visually mixed with the still or moving images and the camera routes and station points can be connected, compared, stored on storage media and visualized with travel segments based on real routes and path vectors.

When site points, street, path, route, flight and ship route vectors as well as grid map information with supplementary information from other sources are available to the computer, these elements can be combined, mixed, processed, transmitted and/or stored with the camera coordinates captured on-site.

Useful supplementary information comprises, for example, the following: geo-referencable physical-technical information such as absolute or relative altitude, longitude, latitude and height of an object, group, amount, speed, direction, density, specific gravity, mass, measurement, seismic, sound, age, vegetation, concentration, state, weight, flow, deviation, temperature, radiation, intensity, limit, usage, statistical and operating information; administrative information re border lines, divisions, groupings, classifications, cultural, linguistic, ethnic and educational groupings; supplementary text information for tourist sites and attractions; image, audio and video sequences; symbols (so-called icons), pictograms and holograms, signatures; coded and uncoded information.

Digital grid maps in various coordinate systems comprise, at the present time, the following: topographic maps, panchromatic images, aerial images in the visible range, satellite images in various frequency ranges, radar images from satellites, magnetoscopic maps/images, area usage maps, vegetation, temperature, ore, oil reserve, other raw materials maps and reserves and seismic maps.

Digital site/POI coordinates in various coordinate systems pertain, at the present time, to cities, tourist sites and many other objects that were already listed above.

Digital vector maps in various coordinate systems comprise, at the present time, the following: building, border, shipping, street, railway, waterway, river, forest, agriculture, usage, vegetation, temperature, ore and oil reserves, other raw materials maps and reserves.

The computer must be provided, in terms of hardware, with an input channel for coded GP information for instance via the RS-232 interface or via a special hardware apparatus for reading the GP information from the film and/or reception via the transmission paths A) or B). The computer must furthermore be provided with a image capture circuit, *i.e.* a so-called frame grabber or video capture, for analog recorded video films or an image capture circuit for digitally recorded video films. In the case of an image capture circuit for digitally recorded video films, the GP information can be contained in the digital audio/image data stream and thus be accessible to the computer without a special input channel therefor.

The software can be equipped with at least one or more functions and data of the following:

- program(s) for reading, processing, storing (special case of so-called data logging), geo-referencing (associating information with coordinates) and, as the case may be, displaying the camera coordinates and/or the further GP information (including the time, time zone computation, world time computation, daylight savings time, etc.), time code and/or user bit evaluation optionally even without land maps.

- the above functions in connection with grid and/or vector and/or site map data and the following further functions:

- selection from available site data (*e.g.* object, city, river names) and vector data (*e.g.* shipping, street, river, border and flight routes) and, without individual coordinates, alter, include, process, transmit and store

- select, alter, include, process, transmit and store site and vector information via coordinates and approximation of coordinates

- transmit the uncorrected positions, the time of the position and further GP information via *e.g.* the internet to the system manufacturer and reception of the corrected data

- reception of DGPS information *e.g.* via the internet and difference correction of the GP information via on-site editing

- geo-referencing objects

- effect computations for various projections, display and lighting forms from available digital maps

- allow various thematic viewing and data levels (so-called layer technique, for instance switch on streets and tourist attractions, tracks and buses, or activate altitude relief representation and draw in borders). The number of combinations grows with the content of the digital map data and is principally only limited by the memory and performance resources of the computer.

- zoom and pan (displace)

- sort/group the data elements in various ways

- transparently or opaquely lay the maps over image/film sequences

- store in and display camera coordinates

- manually input new site or vector coordinates and/or alter existing coordinates or carry out same via program control on the basis of other data sources

- blend in maps before or after image/film sequences with a hard transition or softly via so-called fading

- store the results of such functions on analog or digital, sequential (linear) storage media (video recorder) or non-linearly on digital storage media and reload

- associate text and data (name of the tourist attraction or the site or comments) to the maps and to optionally associate, store and play back or transmit audio information (speech, music) or video information (image, movie) to such objects

- rotate, invert, stretch, compress, transform, distort, sharpen, alienate, re-project, colorize, overlay or mix with other data, sounds, images, movies, etc., visually perceptively alter or improve maps

- convert maps into moving and/or lighted and/or animated objects (*e.g.* projection onto the global and rotate, alter distance of the sun/moon)

- manual or program-controlled projection of object names and/or symbols, pictograms (icons) onto the map that indicate that images, film sequences, sounds or text information can be called up there. Load or generate, model, place and store such symbols. Load, alter, display and store pixel coordinates or the various geographic coordinates

- store and display route and/or position histories; compute and display route suggestions

- apply artificial (arithmetic, virtual) surfaces (textures) or real surfaces

- combine or divide maps by placing them next to one another (tiling)

- compress and decompress loss free or lossy, load, store and transmit maps via various methods (for instance JPEG, MJPEG, Wavelet, CinePac, Indeo, Fraktal)

- overlay grids

- store, audio visually and/or visually play back, broadcast and transmit maps and the aforementioned combinations

- allow macro scripts via a macro language (so-called batch or stack processing), control the video recorder/camera, allow video material to run on the computer, store, alter and display small excerpts (so-called thumbnails)

- generalization of vector and site data with/without a not-to-scale (exaggeratedly large) shape, *e.g.* represent houses and mountains as large symbols or icons

- computation/approximation of the position of a predetermined route from the elapsed time (after an hour's flight over the Atlantic, I was here, no GP reception)

- exact positioning of a GP coordinate on a map of lower resolution (*e.g.* a world map with a resolution of 1 km, then position within the kilometer)

- mix, play back, print, export and transmit results. Integrate traffic information (traffic jams, traffic flow, accident sites, parking information, park and ride information, street conditions, weather, traffic density, etc.). Carry out driving and flight simulation via storage and playback of real images and/or video sequences with or without simultaneous display of a map and/or simultaneous representation of artificial scenes (primarily train, ship and street travel or flight films)

- carry our exportation and transmission of data in conformance with OGC standards (OGC = Open GIS Consortium, GIS = Geographic Information Systems)

- rounding off the GP coordinates captured by the camera

- display object information such as trip name (*e.g.* vacation 1996 in Mallorca), date and time by positioning a screen pointer (mouse/cursor). The same for segments of a trip (short trip from Los Angeles to the Grand Canyon)

- displaying the maps in three dimensional form employing topological information of the countryside and/or of the building

- integrate indoor floor plans of buildings into the maps in order to *e.g.* position the recordings in a museum or in a tourist attraction on the floor plan (albeit without GPS support)

- mix and/or overlay satellite and aerial maps onto the maps

- supplement segments of a trip with text or attribute information (take off, intermediate landing, taxi ride, bus ride, sea travel, start, stop, pause) and store as a data bank object and process *e.g.* using different colors.

Further features and advantages of the invention follow from the dependent claims and from the following description of an embodiment based on the drawings.

Brief descriptions of the drawings

Fig. 1 is a schematic overview of a system for processing GPS data and images.

Fig. 2 is a block circuit diagram of part of the system of Fig. 1.

Fig. 3 is a block circuit diagram of a further part of the system of Fig. 1.

Fig. 4 is a circuit diagram of the circuit part of Fig. 2.

Fig. 5 is a circuit diagram of the circuit part of Fig. 3, and

Fig. 6 is an example of a screen display on a computer for illustrating a vacation trip.

Embodiments of the invention

The configuration shown in Fig. 1 comprises a conventional commercial camcorder 1, a GPS receiver 2 having a corresponding antenna 3 that can be an integral component 4, an electronic circuit 5 that receives the GPS data generated by the GPS receiver 2 and converts them into a form suitable for common recording and/or transmission with image data, and, optionally, a radio receiver 6 for reference signals that are supplied from the GPS receiver 2 for immediate or later difference correction of the received raw GPS data.

The aforementioned components of the configuration are all transportable, wherein the GPS receiver 2, the GPS antenna 3, the electronic circuit 5 and, as the case may be, the radio receiver 6 can be mounted in a common small housing that can be mounted on the camcorder 1. A 3-line connecting cable to the camcorder 1 comprises power supply line 7, via which the GPS receiver 2 and the other components (whose connections are not shown) are connected to an internal voltage source of the camcorder 1, a signal line 8 that connects a data output of the circuit 5 to a microphone input 9 of the camcorder 1, and a common ground line (not shown in Fig. 1). If the camcorder is equipped with an audio input for audio signals from other signal sources than a microphone, this can be used in lieu of the microphone input 9, wherein, as the case may be, the level conversion described hereinbelow must be adapted accordingly. The microphone input 9 of the camcorder 1 or, as the case may be, its audio input can be connected to a switch (not shown), via which it can be optionally supplied with GPS data from the GPS receiver 2 or audio signals from a microphone (not shown).

The configuration shown in Fig. 1 furthermore comprises a stationary part that is illustrated in Fig. 1 separated from the above components by a dashed-dotted line. The stationary part comprises a personal computer 10 that, *inter alia*, is equipped with an RS-232 interface (not shown in Fig. 1) and with an image capturing circuit 11 and is connected to a graphics screen 12. The personal computer 10 can access an internal or external databank 13 for land maps and sites. The image capture circuit 11 is, for example, part of a conventional commercial adapter card for video editing and the associated software can access a storage area 14 for movie files that are short image sequences or so-called clips and a conventional commercial video recorder 15 for storing longer movies.

The electronic circuit 5 of the mobile part of the configuration has a further output that can be

connected to the RS-232 interface of the personal computer 10 via a connection cable 16.

The mobile part to the left of the dashed-dotted line is taken along on trips or otherwise on the go. Prior to and during film shooting with the camcorder 1, the GPS data supplied by the GPS receiver 2 for the current geographic position and including the corresponding times are recorded parallel to the images on the audio channel of the camcorder 1.

Later, the further output of the electronic circuit 5 is connected to the personal computer 10 and a video output 17 of the camcorder 1 is connected to the image capture circuit 11. The personal computer 1 reads the stored GPS data and times by means of the circuit 5 out of the camcorder, places the positions, for which images exist, on a land map displayed on the graphics screen 12 by marking these positions *e.g.* with symbols, and it can compute and also display the traveled route based on the positions and times and, as the case may be, given traffic routes. These and further functions that can be carried out by a suitable data processing program were described above and/or will be described hereinafter.

Whereas the data bandwidth of a fully digital camcorder 1 is sufficient to record the GPS data directly onto the audio track of the recording medium subsequent to the signal conversion that will be described in detail further below, the electronic circuit 5 and the camcorder 1 are not directly connected with one another via the signal line 8 in the case of a camcorder with analog recording, but are instead connected via a further electronic circuit 18 for temporal dilation of the data or signals. The circuit 18, which can also be integrated into the circuit 5, carries out either a digital speed conversion or an analog frequency conversion on the data/signals in order to adapt the bandwidth of the GPS data to the recording bandwidth of the camcorder 1.

Fig. 2, in which identical components are identified with the same reference signs as in Fig. 1, shows a block circuit diagram of the part 19 of the electronic circuit 5 that serves for recording the GPS data on the camcorder 1 and that is framed by a dashed line.

The GPS receiver 2 outputs the GPS data in NRZ form via an asynchronous RS-232 interface as ASCII (for instance at 9600 or 4800 bps), frequently in NMEA 0183 format. The GPS data

are supplied to a signal converter 20 that converts the data into TTL form whose state levels, with respect to NRZ form, are inverted as well as different with respect to ground. After a further level reduction in a signal attenuation sub-circuit 21, the GPS data are supplied directly to the microphone input 9 of the camcorder 1.

As can be seen in the figure, the respectively transmitted signal shapes of an example bit sequence "10110" that are transmitted, true to bit, to the camcorder 1 are illustrated below the various line segments in the chain from the GPS receiver 2 via the signal converter 20 and the signal attenuation sub-circuit 21 to the camcorder 1 in Fig. 2.

A radio receiver 6 for reference signals is optionally provided that has its own antenna 22 whose output signal is supplied to the GPS receiver 2 via an RS-232 interface or the like in the standard format RTCM for differential GP or another suitable format.

As a further option, an electronic 2D or 3D camera can be provided that determines the direction, on the four points of the compass, in which camera lens is pointing and, in the three dimensional case, also detects the camera angle. Since an individual GPS data message does not exceed a particular length within the transmission bandwidth, and a message is transmitted *e.g.* once per second, vacancy periods occur on the interface. The compass data, which are very short, can be inserted onto the interface in these breaks simply as short data sets after the GB transmission. To accomplish this, the compass 23 can comprise a special circuit part that discloses vacancies and thus then attaches its own direction data (either at RS-232 level, as shown in Fig. 2, or at TTL level), in order to record the direction data together with the GPS data on the magnetic tape of the camcorder 1.

Power supply connections of the GPS receiver 2, the radio receiver 6, if present, and the electronic compass 23 as well as the circuit part 19 can be optionally connected, via a switch 24, to a positive terminal 25 of the internal voltage source of the camcorder 1 (frequently +5V) or to an external voltage source 26. The return line of the supply current is effected via a grounded coaxial shield 27 of the connection line between the circuit part 19 and the camcorder 1.

Fig. 3, in which identical components are identified with the same reference signs as in Fig. 1 and 2, shows a block circuit diagram of the part of the electronic circuit 5 that serves to transmit GPS data recorded on the camcorder 1 to the personal computer 10. This signal regeneration part can either be integrated with the mobile circuit part 19 or be a separate, stationary component. A power saving circuit for deactivating the mobile circuit part(s) is practical, by the way, in the case of non-use.

The signal regeneration circuit comprises an impedance adjustment sub-circuit 30, an amplifier 31, an impulse divider 32, an inverter 33, an impulse generator 34 that is *e.g.* a flip-flop, and a signal converter 35 that converts the GPS data from TTL form into NRZ form. All of these components can be supplied with voltage via a switch 36 from either the terminal 25 of the internal voltage source of the camcorder 1 or from an external voltage source 37.

An audio output 38 of the camcorder 1 supplies a low-level output signal that is adjusted in the impedance adjustment sub-circuit 30 to the reference level 0V. The amplifier 31 and the impulse divider 32 generate a positive impulse for each rising flank of this signal and a negative impulse for each falling flank and, therefrom, two parallel signals having positive impulses that are inverted and made rectangular in the inverter 33. The two parallel signals control the impulse generator 34 that generates corresponding TTL impulses therefrom. After conversion into NRZ form in the signal converter 35, the GPS data are supplied to an RS-232 interface 39 of the personal computer 10.

The respectively transmitted signal shapes of an example bit sequence "10110" that is transmitted, true to bit, to the camcorder 1 are illustrated below the various line segments in the chain from the camcorder 1 to the personal computer 10 in Fig. 3. One should note that the output signal of the signal regeneration part in Fig. 3 has exactly the same shape as the input signal of the circuit part 19 in Fig. 2.

As is schematically illustrated in Fig. 3, the personal computer 10 comprises, *inter alia*, the image capture circuit 11 that is connected to the video output 17 of the camcorder 1, the RS-232 interface 39, programs 40, map data 41 and a communication terminal 42 *e.g.* for the internet. The communication terminal 42 allows a data exchange with an external computer

43 for a difference correction of the GPS data based on reference data through editing in case the personal computer 10 cannot carry out the difference correction itself due to lack of reference data or software.

Fig. 4 shows an example of a detailed embodiment of the circuit part 19 of Fig. 2. The GPS data are supplied to the RS-232 input of a CMOS MAX 232 IC. Its output is connected to the microphone input ("Mic") 9 of the camcorder 1 via a capacitor and a potentiometer as a signal attenuating sub-circuit and, if necessary, via another RC sub-circuit.

Fig. 5 shows an example of a detailed embodiment of the signal regeneration part of Fig. 3 that is somewhat more complex that the circuit part 19. In Fig. 5, an op-amp LM 324 corresponds to the impedance adjustment sub-circuit 30 (cf. Fig. 3); the subsequent op-amps configured in parallel correspond to the amplifier 31 and the impulse divider 32; the IC 7404 corresponds to the inverter 33; the IC 7474 corresponds to the impulse generator 34; and the IC MAX 232 is wired to form the signal converter 35.

An example for the presentation and processing of images and GPS data captured during a trip by means of a corresponding data processing program on a personal computer will now be described based on Fig. 6. First a world map is shown, in this example in the form of a parallel projection onto the globe that is rotatable *e.g.* by means of cursor and mouse in the direction of the arrows drawn on the world map 44. Once the user has turned the relevant part, in this case Europe, to the front and the data processing program has read and evaluated the data recorded on the camcorder, a traveled route 45 appears on the world map 44, in this case a flight from Hannover in Germany to Mallorca in Spain. The travel route can stick to given flight paths from available map material and/or draw a curve through known start, destination and flight points.

The user marks, *e.g.* via cursor and mouse, a section on the world map 44 around the travel route 45 that, in response to a further action, is displayed in enlarged form. In Fig. 6, this is shown to the right below the world map 44, which can optionally remain visible. The data processing program marks, based on the camera coordinates, or the user marks the starting point and the destination point of the trip, for which captured images exist, with symbols. The

symbols can be manually or automatically substituted by the illustrated captions for the corresponding sites from a town/site directory stored in the computer. In this example, the user had furthermore input that the city of Fulda was flown over, which was announced, by chance, during the flight. One thus has the possibility to specify the traveled route in further detail without having to constantly film or even without GPS reception. The user or the data processing program can retrieve the geographic coordinates for the city of Fulda from the town/site directory.

The user subsequently selects a map section around the destination point and zooms in until, in addition to the above maps, or subsequent thereto, the island of Mallorca is shown on the screen, illustrated in the lower part of Fig. 6. This map contains larger details such as rivers, isohypses (lines of identical altitude) 46, singular altitude information ("1445 m"), traffic routes, cities and city names. The data processing program computes, based on the capture sites and times as well as traffic routes given by the user, the particular course of the traveled route, in this case a segment 47 illustrated by a dashed line for the bus ride from the airport to the hotel and a segment 48 illustrated by a dotted line for an excursion to the Inca cave. In areas in which the data processing program cannot or should not stick to available traffic routes for the traveled route, for instance because one has traveled through non-mapped area, the isohypses 46 represent advantageous additional information for comparison with the distance to the center of the earth stored with the images so that the data processing program can "freehandedly" draw in the traveled route.

Furthermore, in the same screen interface as in Fig. 6, *e.g.* as windows between the land maps, or in a new screen interface, tables can be shown in which the single images or films that were captured during the trip are listed together with data such as *e.g.* the duration of the respective recording, site name, date, time, geographic longitude and latitude, geographic altitude, direction of the four points of the compass in which the recording occurred, camera angle with regard to the horizon, columns for entering one's own information, etc. From this, the user can put together an editing list for a complete movie in which, for illustration, even the maps are included and output this movie to the video recorder 15 (Fig. 1).

CLAIMS

1. An electronic circuit (19) having an input that receives geographic position data that are coded as serial digital signals and an output that outputs the geographic position data in the form of signals that are suitable for recording onto an audio channel of a camcorder (1), characterized in that the electronic circuit (19) essentially consists of a level converter (20, 21) or of a signal inverter (20) and a level converter (20, 21) that solely carries/carry out a level conversion and/or inversion to the serial digital signals in order to record the level converted and/or inverted serial digital signals, as they are, onto the audio channel of the camcorder (1).

2. The electronic circuit of claim 1 as component of a system for the reading out and processing of image data recorded in the camcorder and geographic position data that furthermore comprises a data processing program that is adapted to display at least one digital land map on a screen (12), to display the capture sites of images or image sequences represented by the image data on the at least one land map and to display, when the user selects a capture site, the corresponding images or image sequences, characterized in that the at least one digital land map comprises at least one digital world map (44) that is displayed in the form of a parallel projection onto the globe, wherein the global is virtually rotatable by the user.

3. The system of claim 2, characterized in that the data processing program comprises an editing program or can collaborate with an editing program such that a movie for recording on a video recorder (15) can be put together from at least one land map (44) selected by the user as well as images or image sequences selected by the user.

4. The system of one of the preceding claims, characterized in that the data processing program comprises a communication program or can collaborate with a communication program (42) such that recorded geographic position data are sent for an external difference correction and the corrected position data are received back.

Abstract

System for processing geographic position data and images and circuit for said system

The invention relates to a system for processing geographic position data and images comprising an electronic circuit (5) having a first circuit part (19) for input of geographic position data and for output of the position data in a form suitable for common recording and/or transmission with image data and a second circuit part (30-35) for input of position data recorded together with image data and for their output in computer-readable form, and comprising a data processing program that is adapted to display at least one digital land map (44) on a screen (12) and to display the capture sites of the images or image sequences represented by the image data on the at least one map and to display, when the user selects one of the capture sites, the images or image sequences corresponding thereto on the screen. The invention allows *e.g.* an amateur movie maker equipped with a camcorder (1), a GPS receiver (2) as well as a personal computer (10) to reference the captured image sequences in a simple manner to the corresponding capture sites.

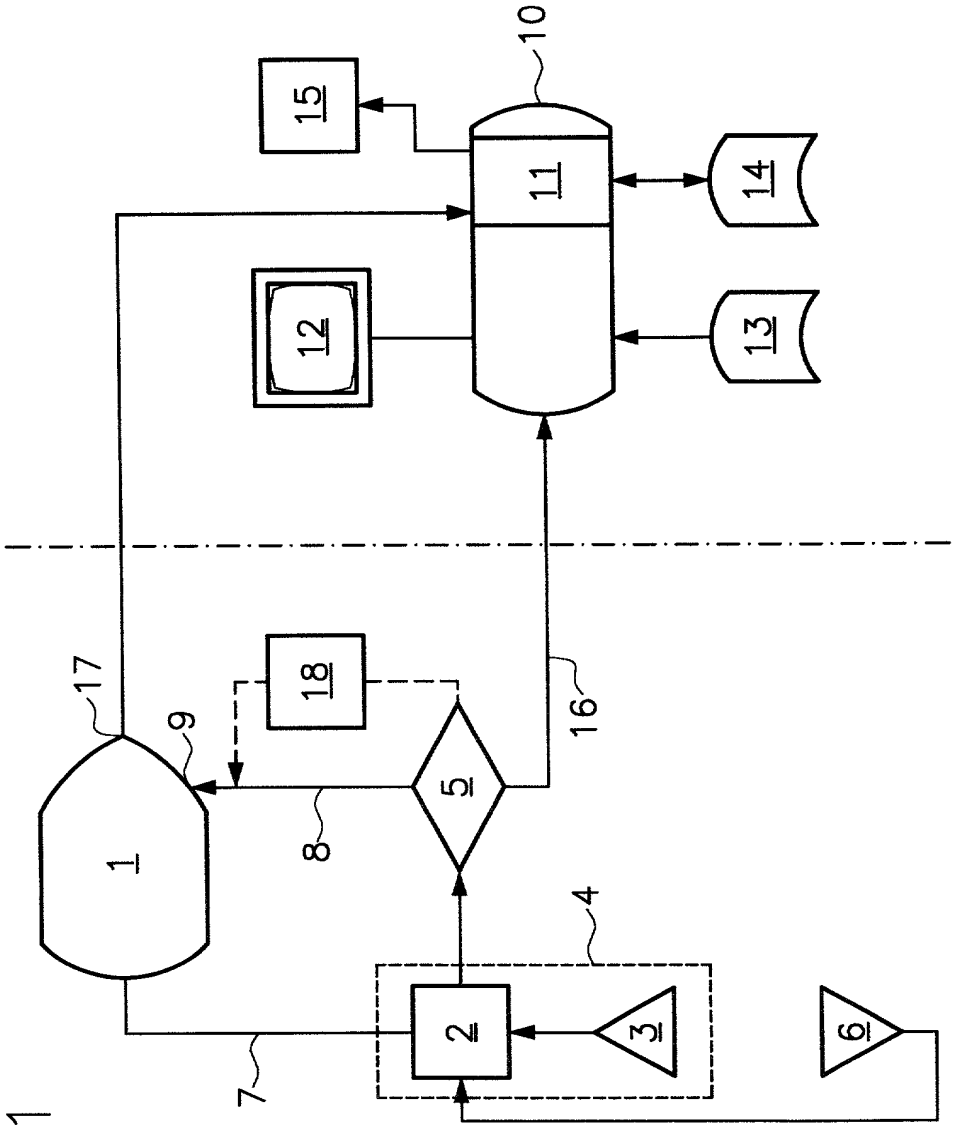
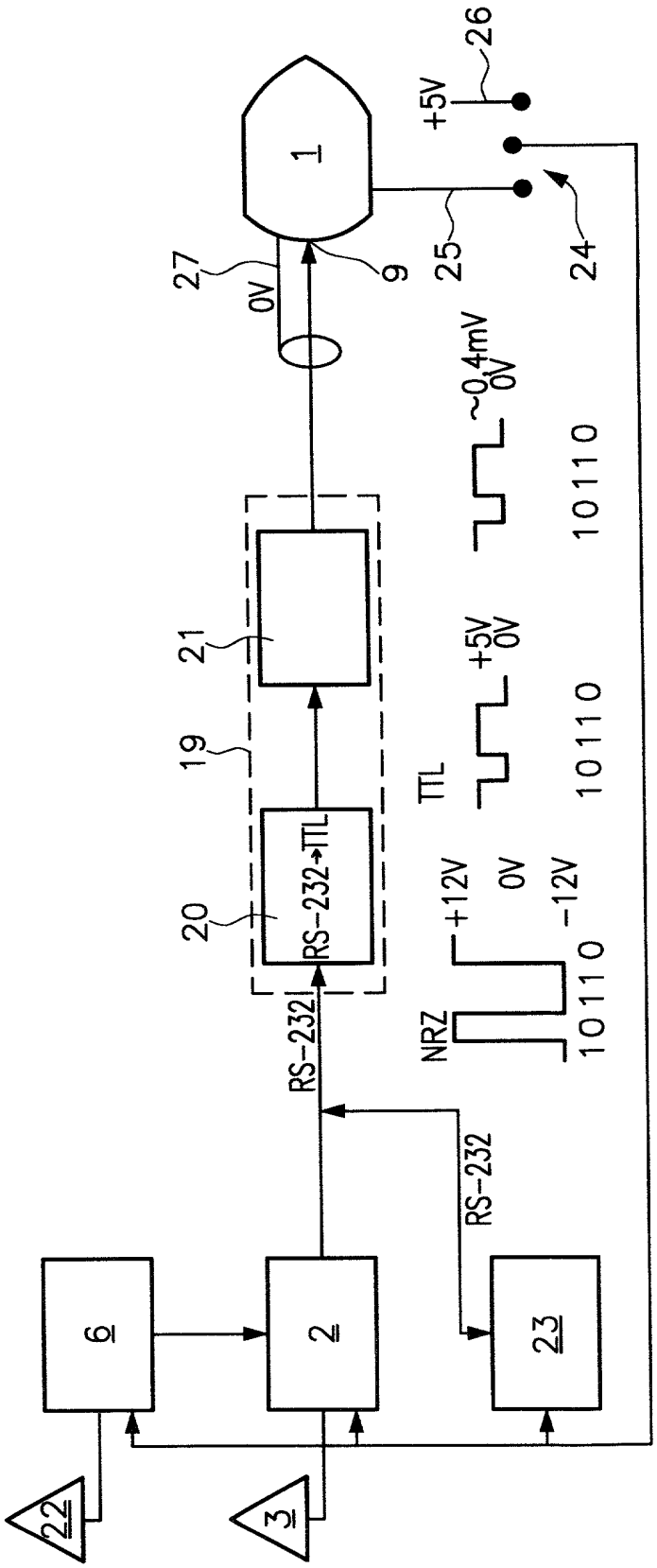


FIG. 1

FIG.2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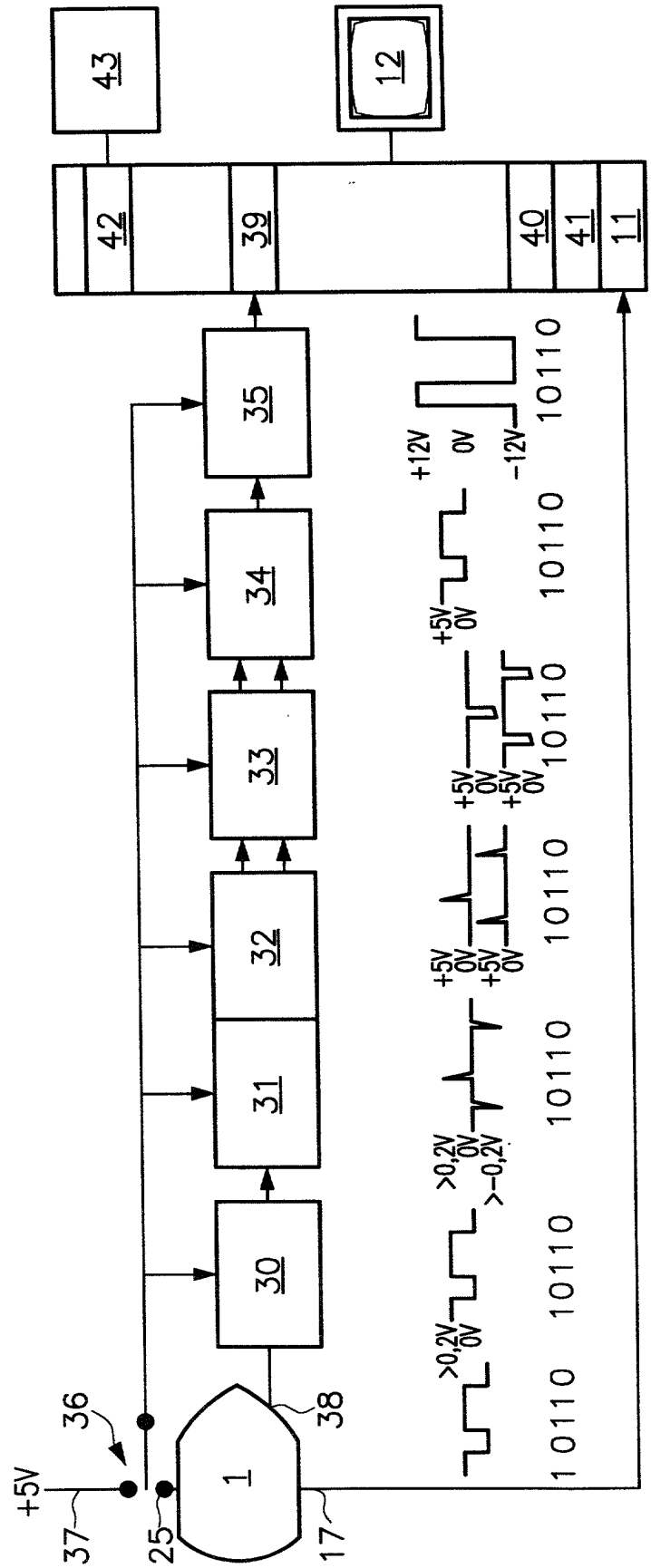
+5V
26
25
24
27
0V
9
~0.4mV
0V
10110
21
19
+5V
0V
TTL
10110
20
RS-232→TTL
+12V
0V
-12V
NRZ
10110
RS-232
RS-232
6
2
23
22
3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12
42
39
40
41
11
35
34
33
32
31
30
1
36
37
25
17
38
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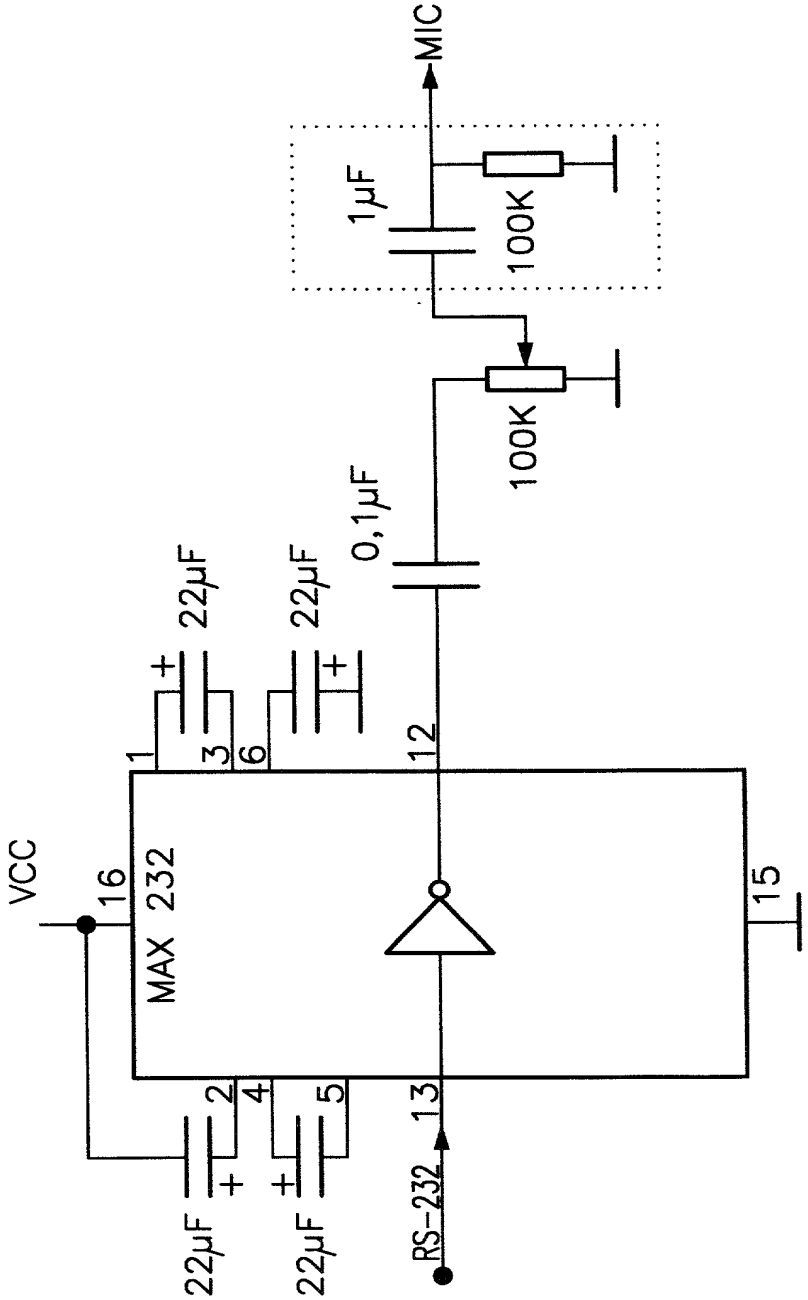
0V
-12V
10110
>0,2V
>-0,2V

FIG.3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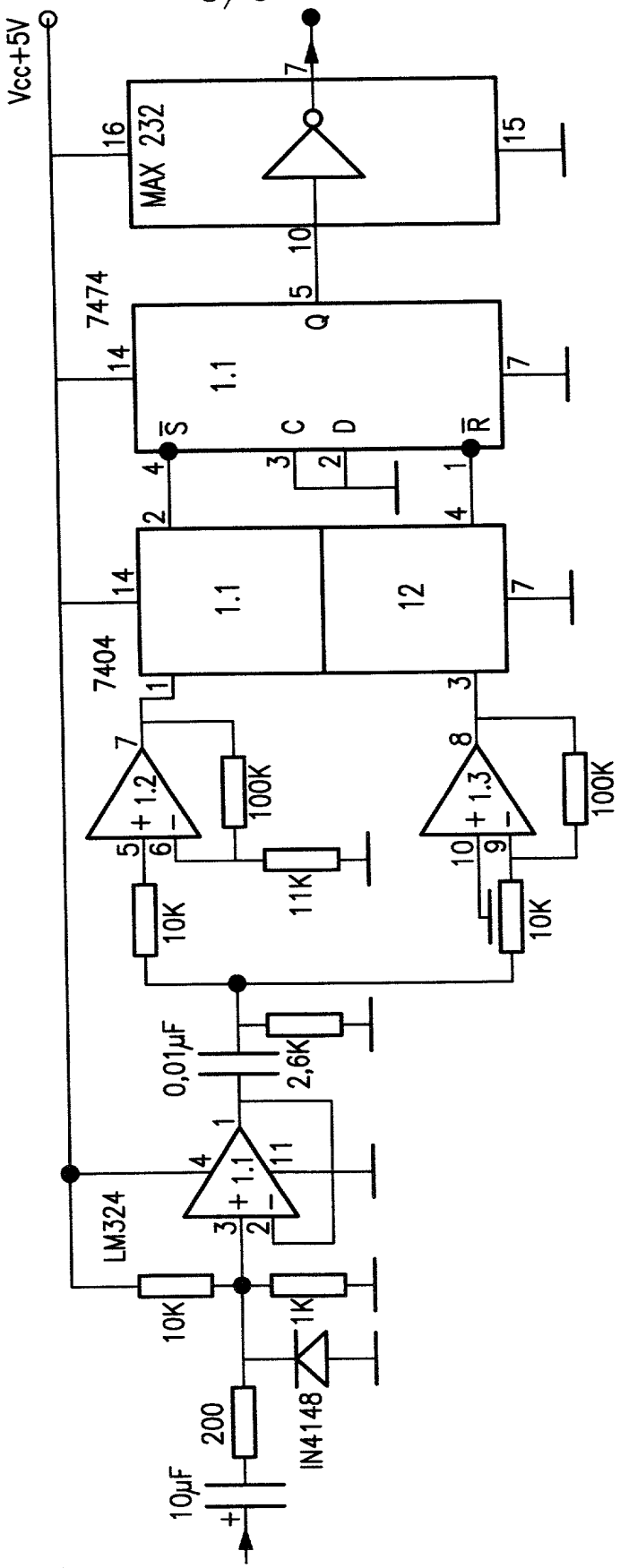
100K
100K
0,1µF
22µF
22µF
VCC
16
MAX 232
1
3
6
12
15
2
4
5
13
22µF
22µF
RS-232

FIG.4


Vcc+5V
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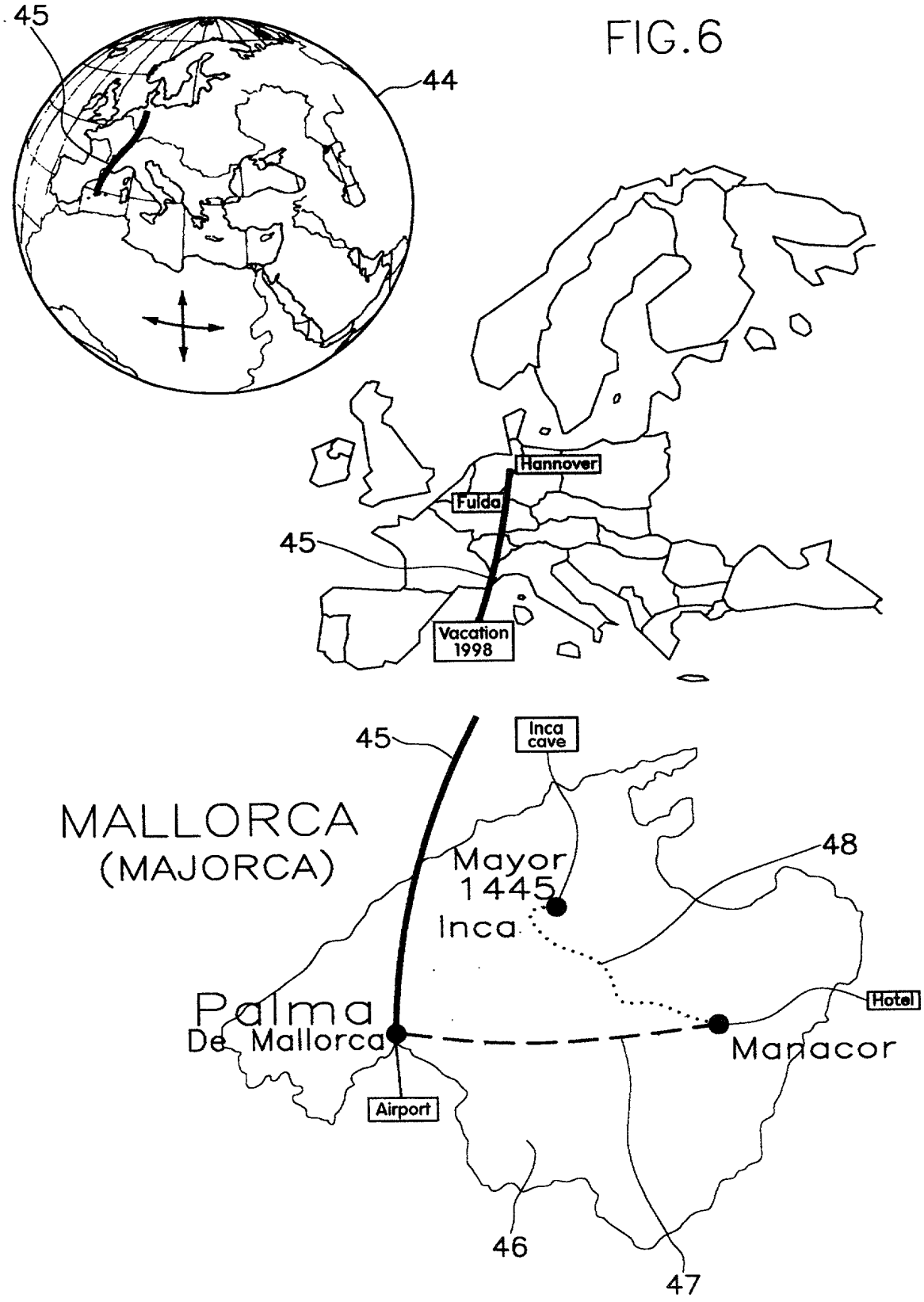
16
15
7
10
7474
14
1.1
Q
S
C
D
R
5
3
2
4
1
7
14
1.1
12
7404
1
3
7
8
+ 1.2
+ 1.3
5
6
10
9
100K
100K
11K
10K
10K
0,01µF
2,6K
LM324
+ 1.1
4
11
1
3
2
10K
1K
200
IN4148
10µF

FIG.5

FIG.6


45
44
Hannover
Fulda
45
Vacation
1998
45
Inca
cave
MALLORCA
(MAJORCA)
Mayor
1445
Inca
48
Palma
De Mallorca
Hotel
Manacor
Airport
46
47

Docket No.:_____

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: System for processing geographic position data and images and circuit for said system, the specification of which

__X__ is attached hereto
____ was filed on _____ as Application Serial No. _____
____ and was amended on _____ (if applicable).
__X__ I hereby authorize and request our attorney, Davidson, Davidson & Kappel, LLC. of 485 Seventh Avenue, New York, New York 10018 to insert here in parentheses (Application number _____, filed _____) the filing date and application number of said application when known.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information which is known to me to be material to the patentability of this application as defined in Title 37, Code of Federal Regulations, §1.56

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign and/or provisional application(s) for patent or inventor's certificate listed below and have also identified below any foreign and/or provisional application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR APPLICATION(S)			Priority claimed	
198 41 262.2 (Number)	Germany (Country)	09/09/1998 (Day/Month/Year Filed)	X Yes	___ No
PCT/EP99/06531 (Number)	PCT (Country)	06/09/1998 (Day/Month/Year Filed)	___ Yes	___ No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial Number)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial Number)	(Filing Date)	(Status) (patented, pending, abandoned)

11

And I hereby appoint Clifford M. Davidson, Registration No. 32,728, Leslye B Davidson, Registration No. 38,854, Cary S. Kappel, Registration No. 36,561, William C. Gehris, Registration No. 38,156, Morey B. Wildes, Registration No. 36,968, Robert J. Paradiso, Registration No. 41,240, Scott L. Appelbaum, Registration No. 41,587, Cynthia R. Moore, Registration No. 46,086, David Knasiak, Registration No. 45,991, Erik R. Swanson, Registration No. 40,833, Salvatore J. Maiorino, Registration No. ~~42,830,~~ my attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, correspondence address: DAVIDSON, DAVIDSON & KAPPEL, LLC, 485 Seventh Avenue, 14th Floor, New York, New York 10018; Telephone: (212) 736-1940; Fax: (212) 736-2427

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Full name of joint Inventor, if any _____

Third Inventor's signature _____
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Residence (city) _____, (state or country) _____
Citizenship _____
Post Office Address: _____

Full name of joint Inventor, if any _____

Fourth Inventor's signature _____
Date _____
Residence (city) _____, (state or country) _____
Citizenship _____
Post Office Address: _____